
Experiment title:

- a) Structures of thin liquid films induced by (rough) substrates
- b) A study of thermal fluctuations within thin liquid films

Experiment number:
 [REDACTED]

Beamline:

ID10B

Date of Experiment:

from: 20-Nov-98 7:00 to: 1-Dec-98 7:00

Date of Report:

18-Feb-99

Shifts:

30

Local contact(s):

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Preliminary Report:

We have carried out x-ray reflectivity, diffuse scattering and grazing incidence diffraction measurements on a series of liquid perfluorohexane films in the thickness range of $d = 30\text{\AA} \dots 230\text{\AA}$. The aim of the experiment was to explore the internal structure of thin wetting films varying in thickness and shape of the film molecules. The occurrence of 'structure' in liquids arises first and foremost from the geometry of the molecules. The geometric constraining effect in thin films and the interaction film/solid is assumed to force the molecules to order into quasidiscrete layers. A recent examination of n-hexane and cyclohexane wetting films on smooth oxide-covered silicon wafers revealed a less packed interfacial region near the liquid/solid interface [4]. *Plischke et al.*[1] have shown by solving integral equation theories for inhomogeneous fluids, that a gaseous film may develop in less dense packed fluids near a hard wall.

A series of reflectivities from perfluorohexane films on Si/SiO₂ were measured at ID10B. The analysis of the data has been done by applying a new inversion method. In comparison to the data obtained from cyclohexane and n-hexane wetting films, perfluorohexane reveals just a small, less dense packed region. The diffuse scattering measurements, carried out on thick perfluorohexane films, show typical power laws which are characteristic of the presence of capillary waves at the liquid/gas interface.

At ID10B, due to the high brilliance, we were also able to record for the first time the in-plane pair-correlation in perfluorohexane films as a function of the penetration depth of the incidence beam [5].

As one example figure 1 shows a series of grazing incidence measurements carried out on a perfluorohexane film of thickness $d=144\text{\AA}$ for a number of different incident angles near the critical angle of perfluorohexane ($\alpha_c^{C_6F_{14}} = 0.15^\circ$). In comparison to preliminary results on cyclohexane films no change in the structure factor has been observed by varying the penetration depth of the incident x-rays. This supports the finding from the reflectivity data that the order at the solid/liquid interface is weak for perfluorohexane.

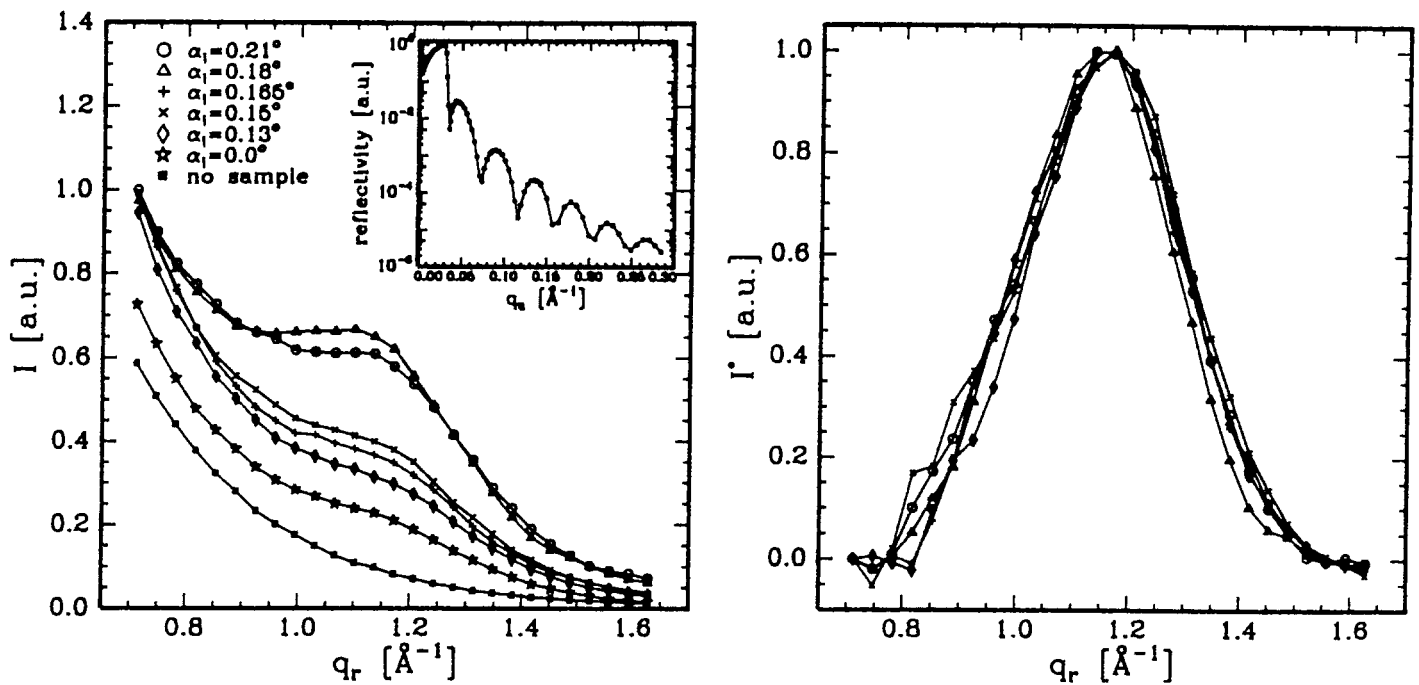


Fig.1: Grazing incidence diffraction measurements of a perfluorohexane film of thickness $d=144\text{\AA}$ (left panel). The measurements have been carried out as a function of penetration depth of the incident beam by varying the incident angle. Subtracting the background and scaling the maxima with respect to each other yields no change in the structure factor by varying the penetration depth of the incident x-rays (right panel).

References:

- [1] M. Plischke, D. Henderson; J.Chem.Phys. 84, 2846 (1986)
- [2] A.K. Doerr, M. Tolan, T. Seydel, W. Press; Physica B 248, 263 (1998)
- [3] A.K. Doerr; PhD Thesis, University of Kiel (1999)
- [4] A.K. Doerr, M. Tolan, J.-P. Schlomka, T. Seydel, W. Press; in preparation
- [5] A.K. Doerr, M. Tolan, T. Seydel, J.-P. Schlomka, D. Smilgies, B. Struth, W. Press; to be published